THA 2019 International Conference on Water Management and Climate Change towards Asia's Water-Energy-Food Nexus and SDGs
23-25 January 2019, Swissôtel Bangkok Ratchada,Thailand
KMUTT

EFFECT OF CLIMATE CHANGE ON WATER MANAGEMENT IN LOWER CHAO PHRAYA RIVER

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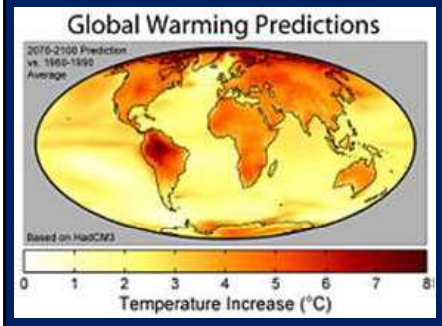
Climate Change



Ice loss from glacier

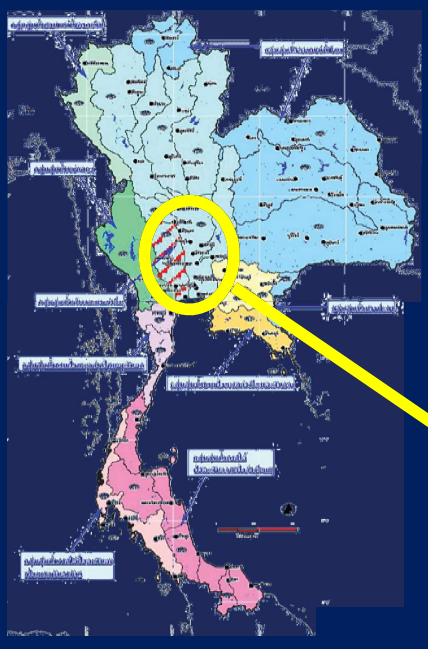
What 'd we do??

Flood damage

Shoreline erosion

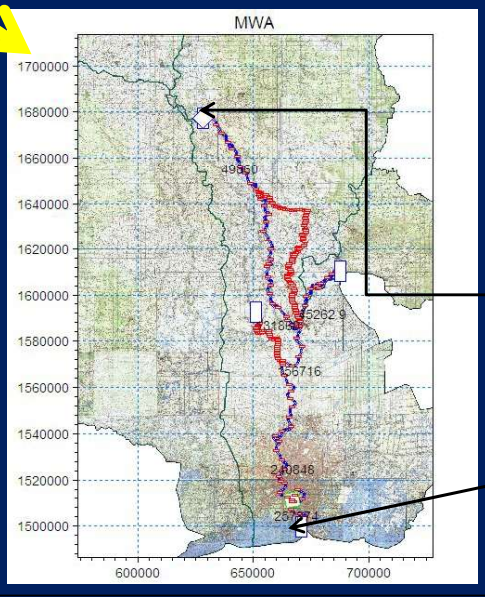
Aims and Objectives

This paper addresses these issues by using a proposed MIKE11 numerical modelling to simulate the effects on sea water level change and salinity intrusion. Performance of the numerical model was applied to simulate flow events in 2100, which are water level change and salinity intrusion on agricultural and raw water supply in the Lower Chao Phraya River, Thailand.



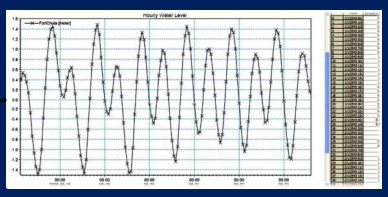
Study area

Chao Phraya River; from Chao Phraya Dam, Chainat province to the Gulf of Thailand

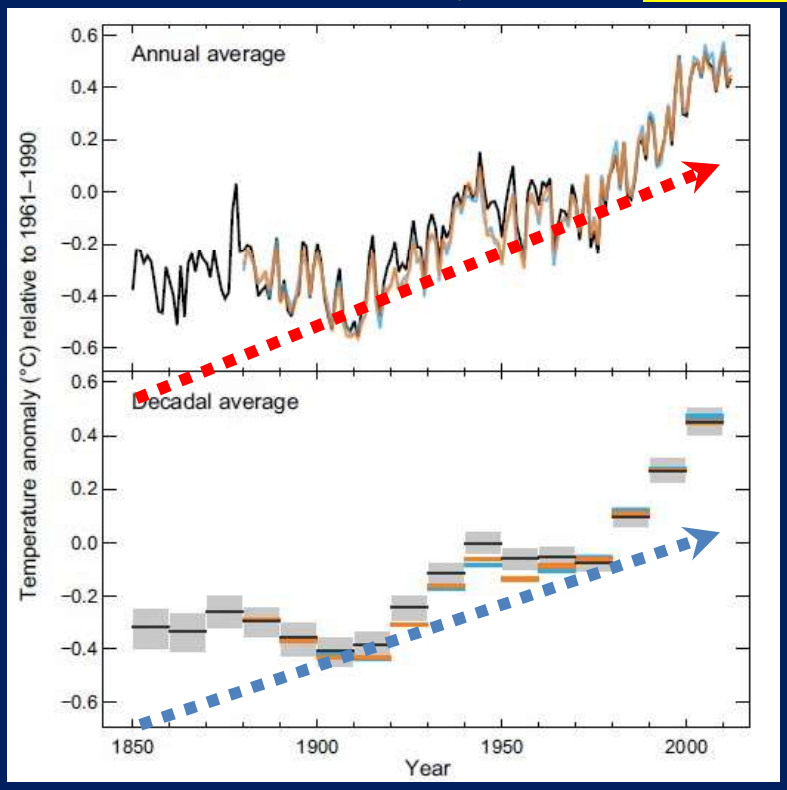


Chao Phraya Dam

Fort Chula



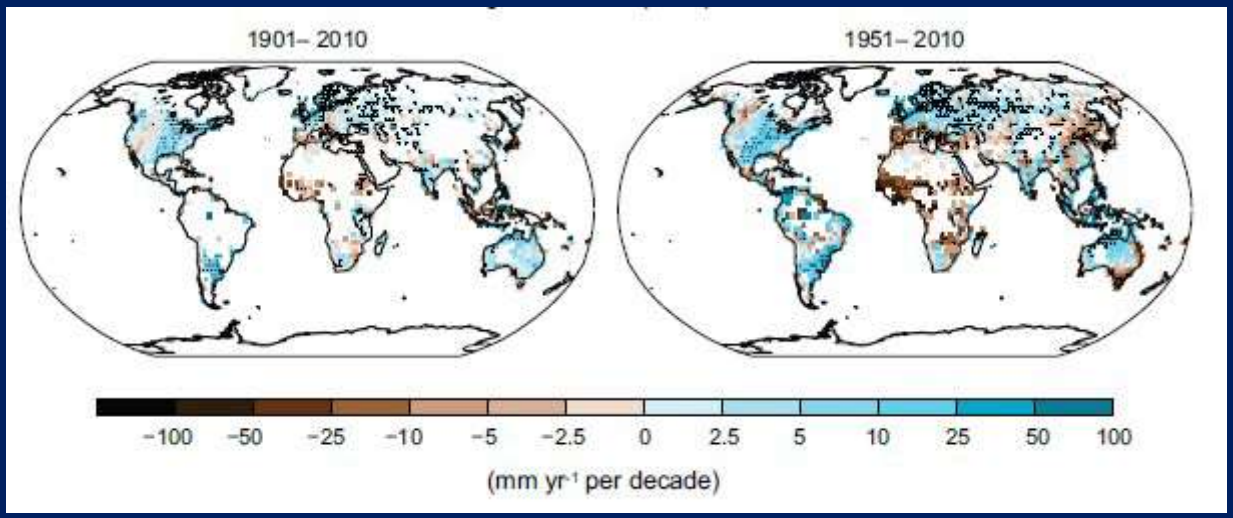
Changes in the Climate System - *Atmosphere*



Observed globally averaged combined land and ocean surface temperature anomaly 1850–2012

(source : http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf)

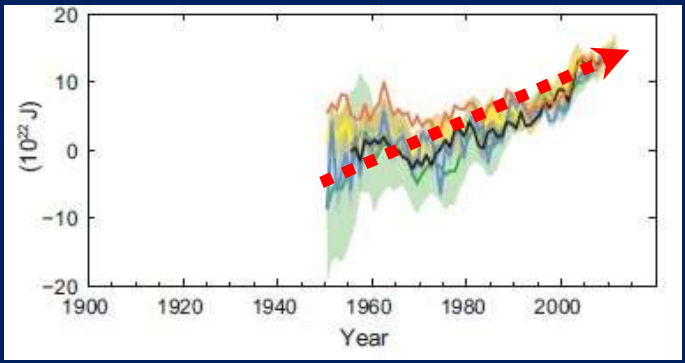
Changes in the Climate System - *Ocean*



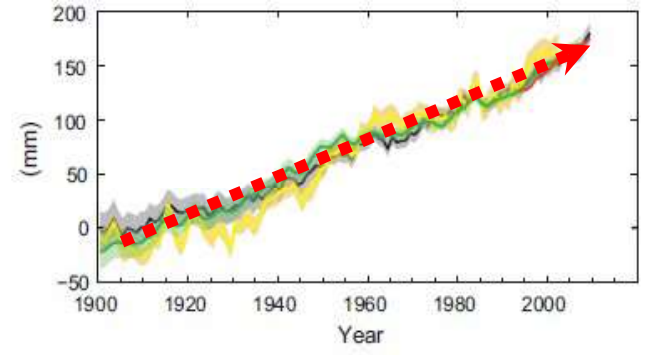
Observed change in annual precipitation over land

(source : http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf)

Changes in the Climate System - *Ocean*



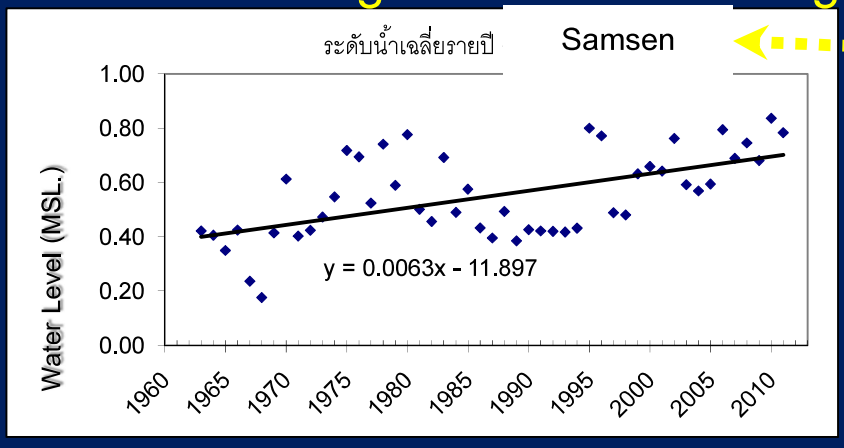
Change in global average upper ocean heat content

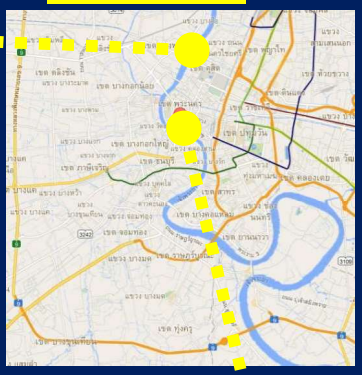


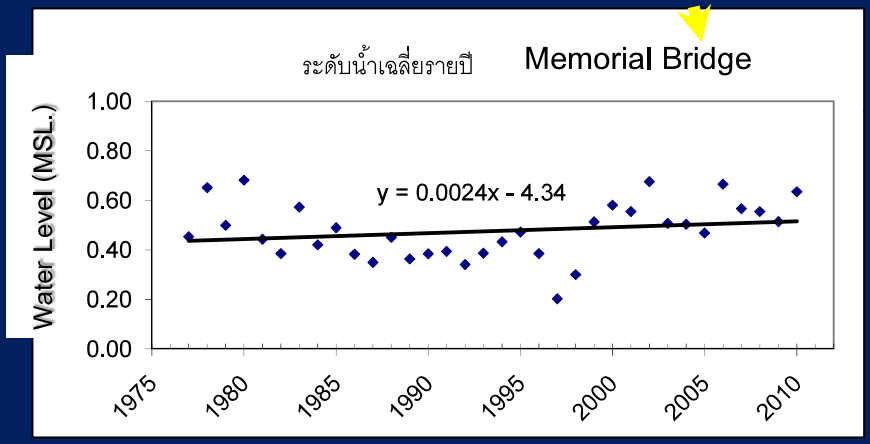
Global average sea level change

(source : http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf)

Average water level change in *Thailand*

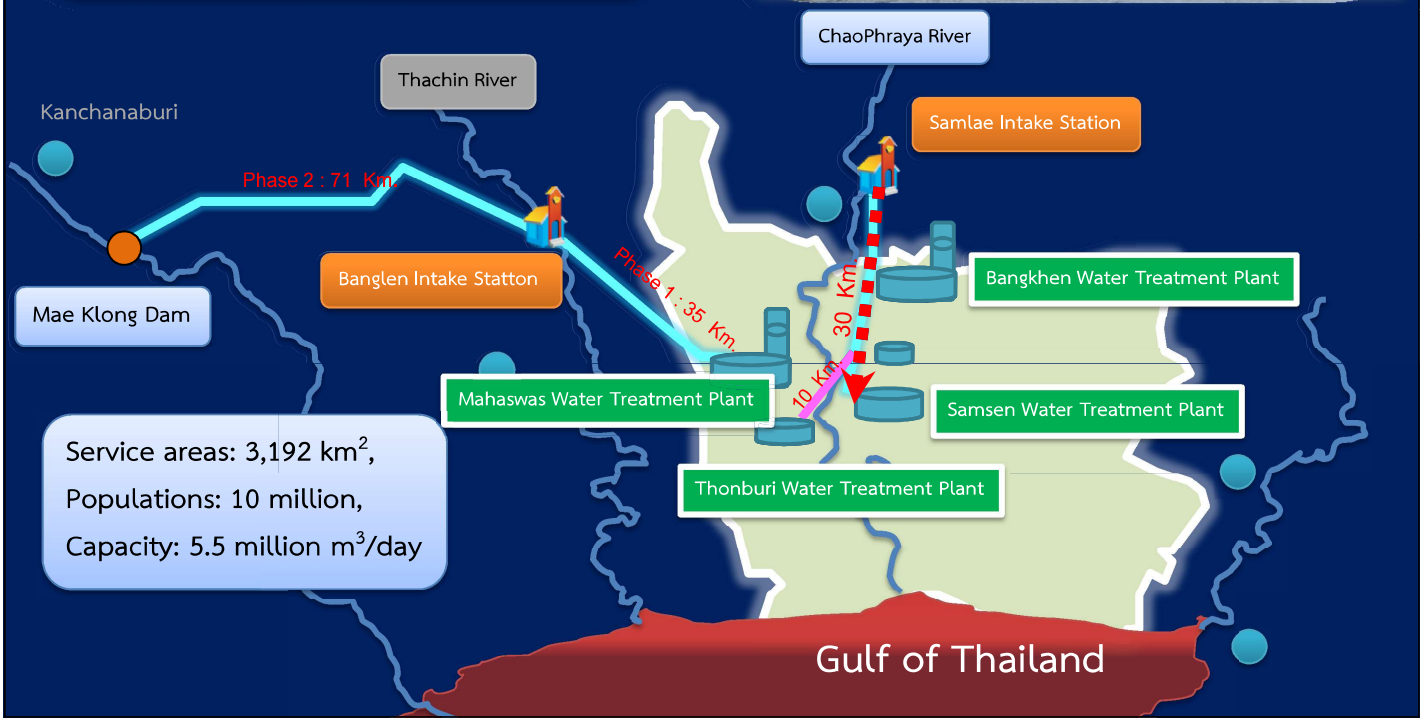






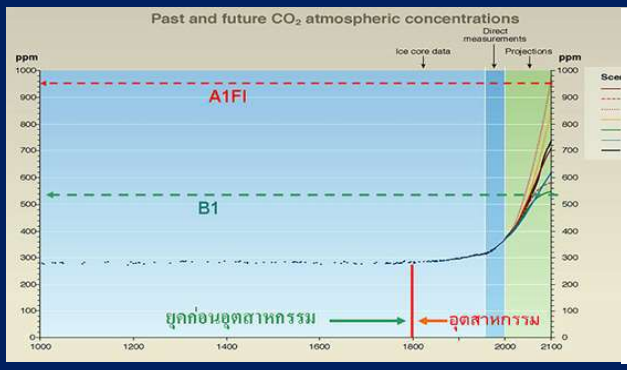
MWA: Metropolitan Waterworks Authority

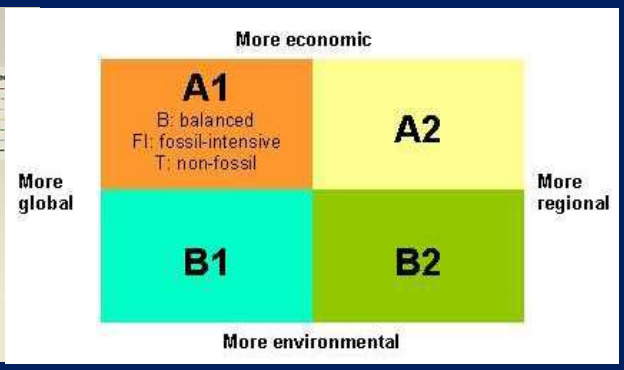
Established in 1914



The projections of possible future climate change

IPCC SRES (Special Report on Emission Scenarios)





A Scenarios More economic focus, rapid economic growth

B Scenarios More environmental focus, global environmental sustainability

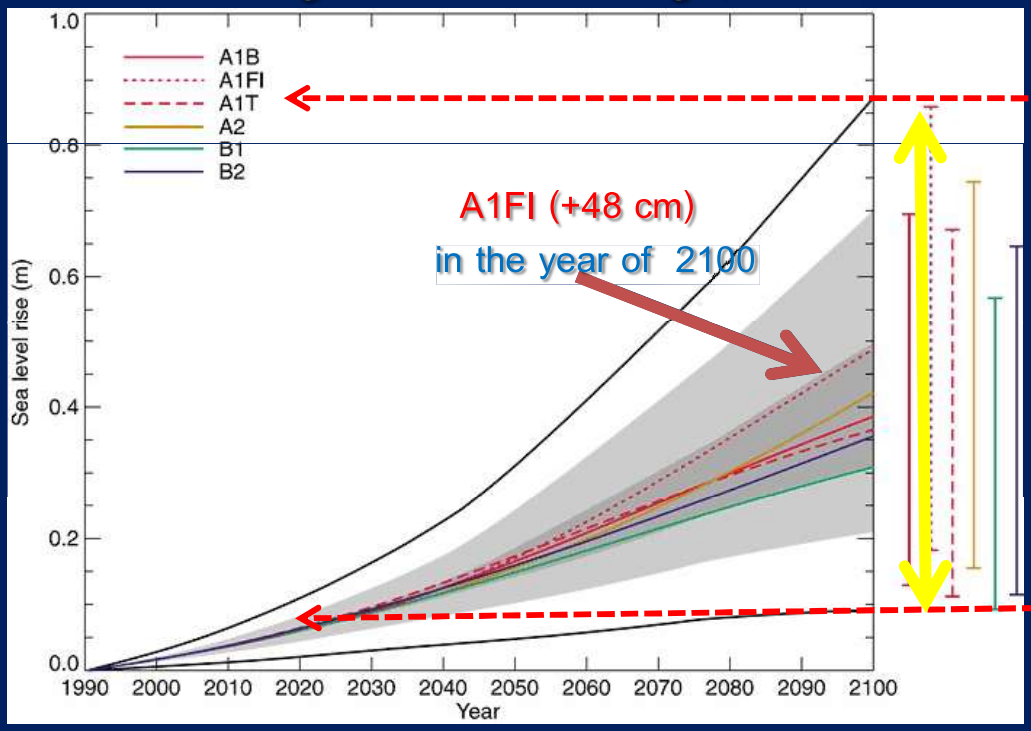
1 Scenarios Globalisation (homogeneous world)

2 Scenarios Regionalisation

: A1FI An emphasis on fossil-fuels (Fossil Intensive)

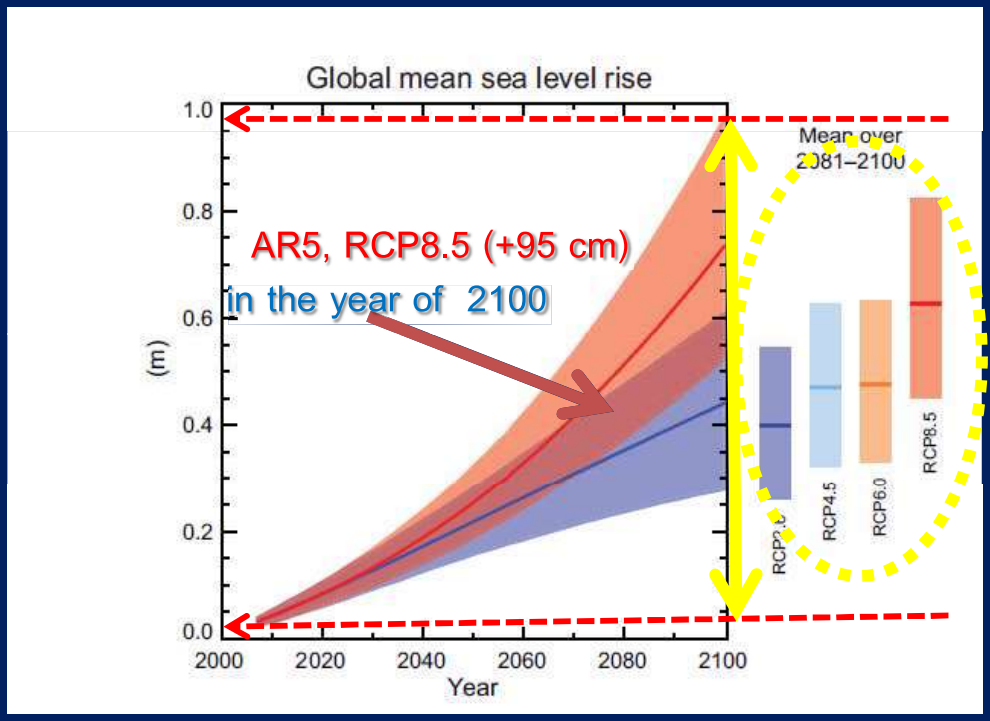
(source: http://www.ubon.go.th/article/detail.php?id=1415)

Projected changes over the 21st century in the Ocean: global average sea level change, IPCC



(source: www.grida.no/climate/IPCC_tar/wg1/fig11-12.htm)

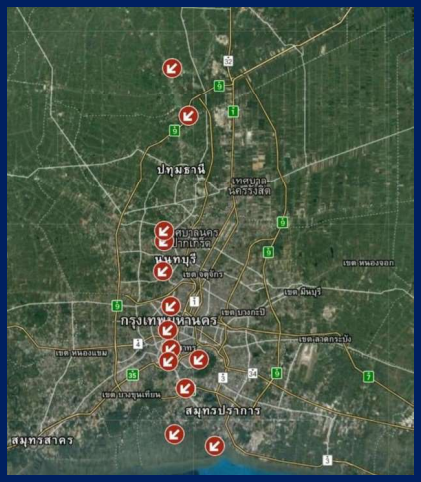
Projected changes over the 21st century in the Ocean: global average sea level change, IPCC

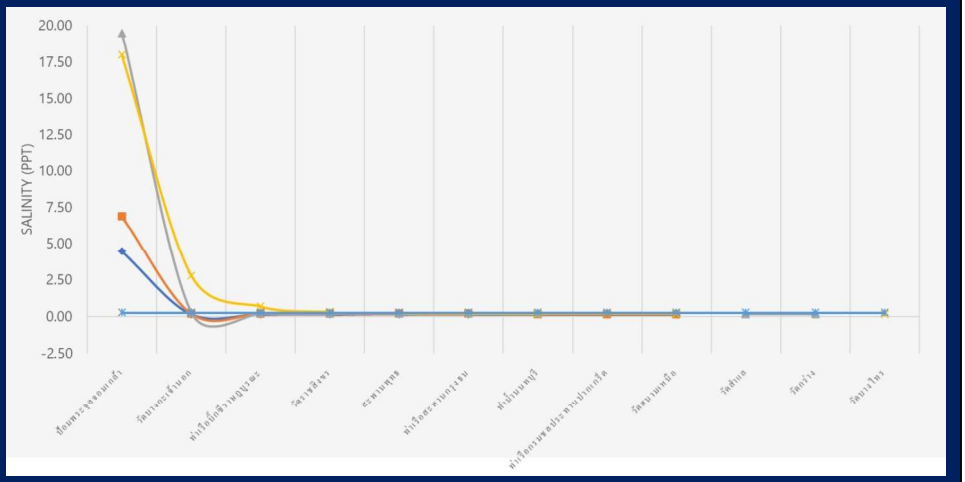


(source: www.grida.no/climate/IPCC_tar/wg1/fig11-12.htm)

Field measurements:12 Locations, Sep.2018-Jan.2019





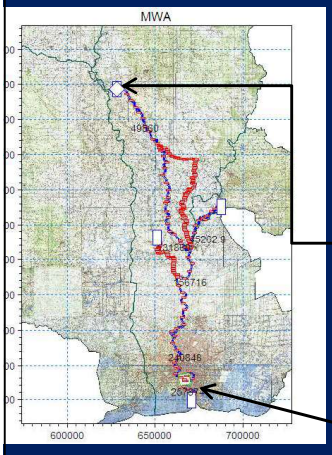


Methodology

(Upstream Boundary: discharges, Q(t)

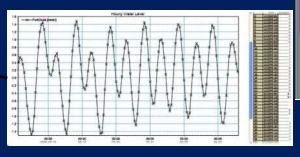
(Downstream Boundary: sea water level, h(t)

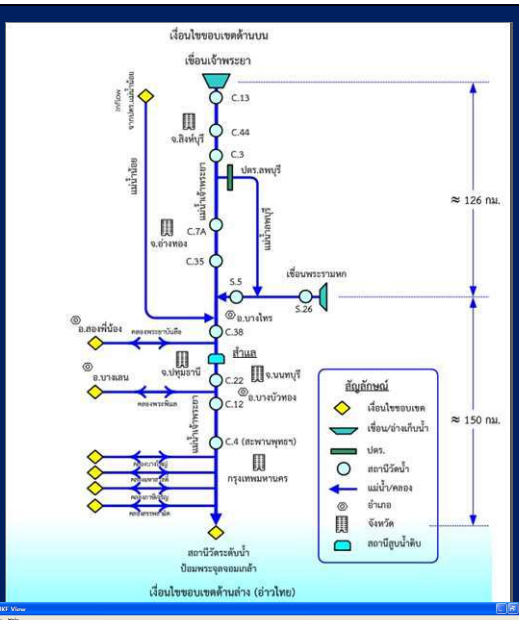
MIKE11 Model

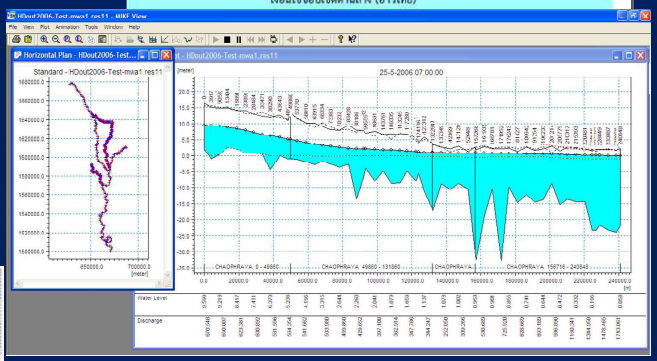


Chao Phraya Dam

Fort Chula







Schematic of Chao Phraya River and longitudinal Profile

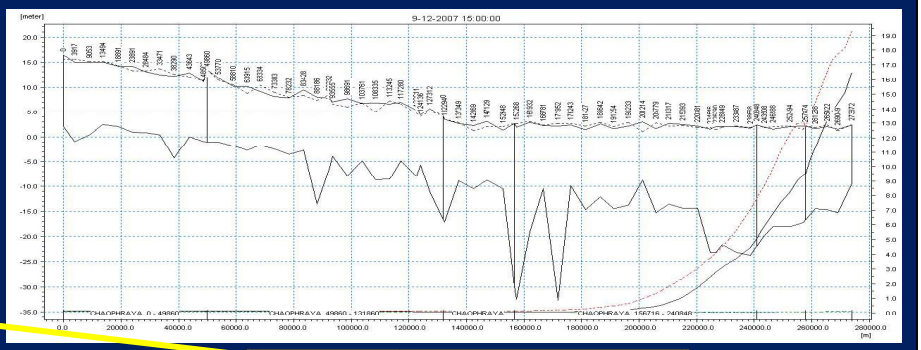
Model calibration & validation

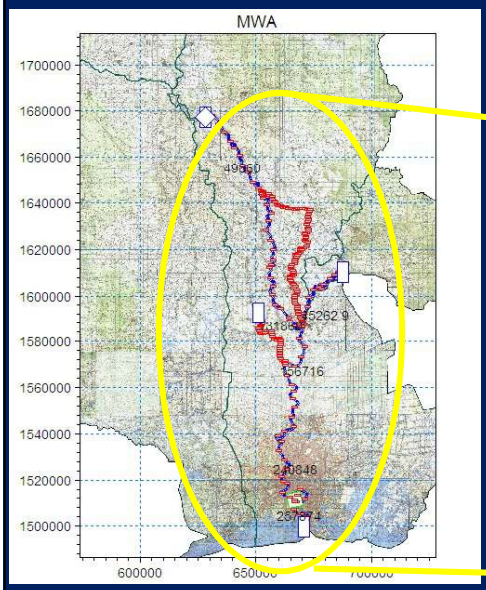
Module	calibration	validation
HD Module	Jan. - Dec. 2010	Jan. - Dec. 2012
AD Module	Jan. - Jun. 2010	Jan. - Jun. 2012

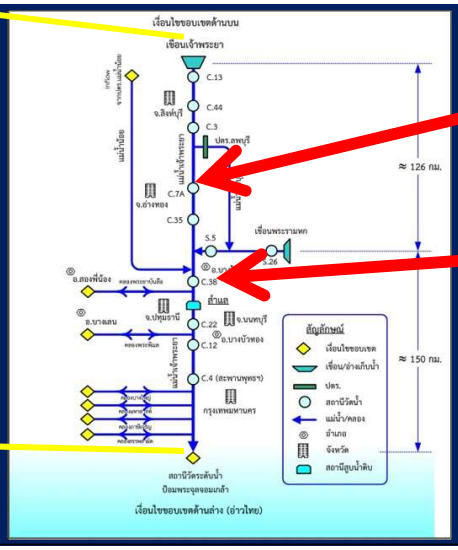
Sea level change: IPCC

Schematic of Chao Phraya River

Model Setup







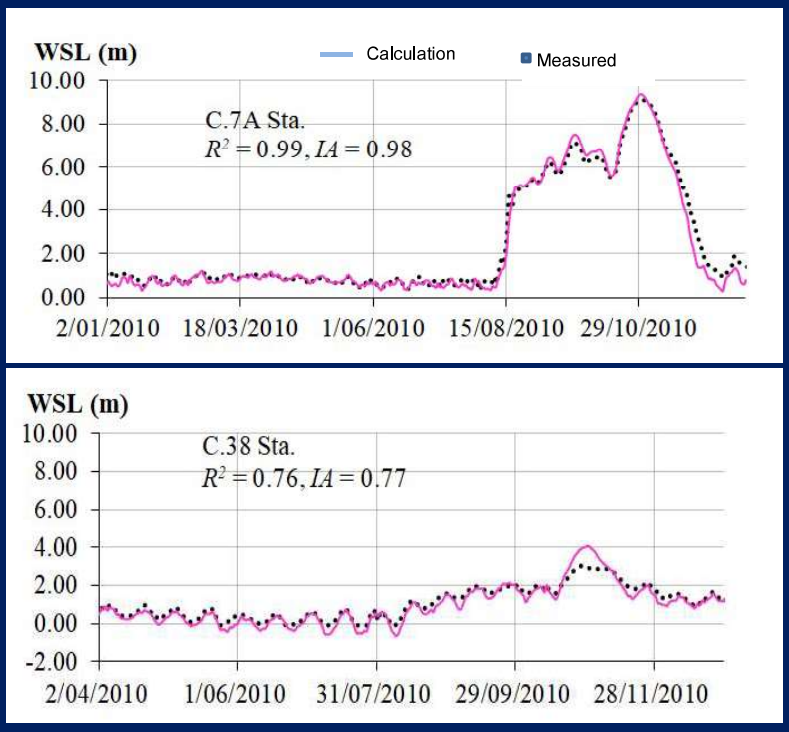
C.7A

Ang Thong

C.38

Pathum Thani

Calibration HD Module (Jan. - Dec. 2010)

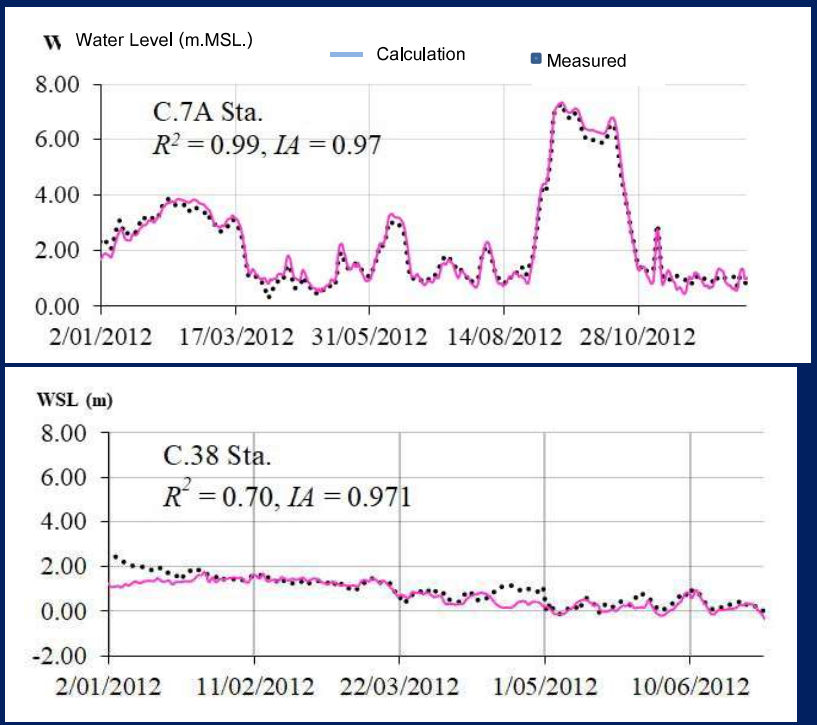


Water Level (m. MSL.)

Time

Manning's coefficient n = 0.030

Validation HD Module (Jan. - Dec. 2012)

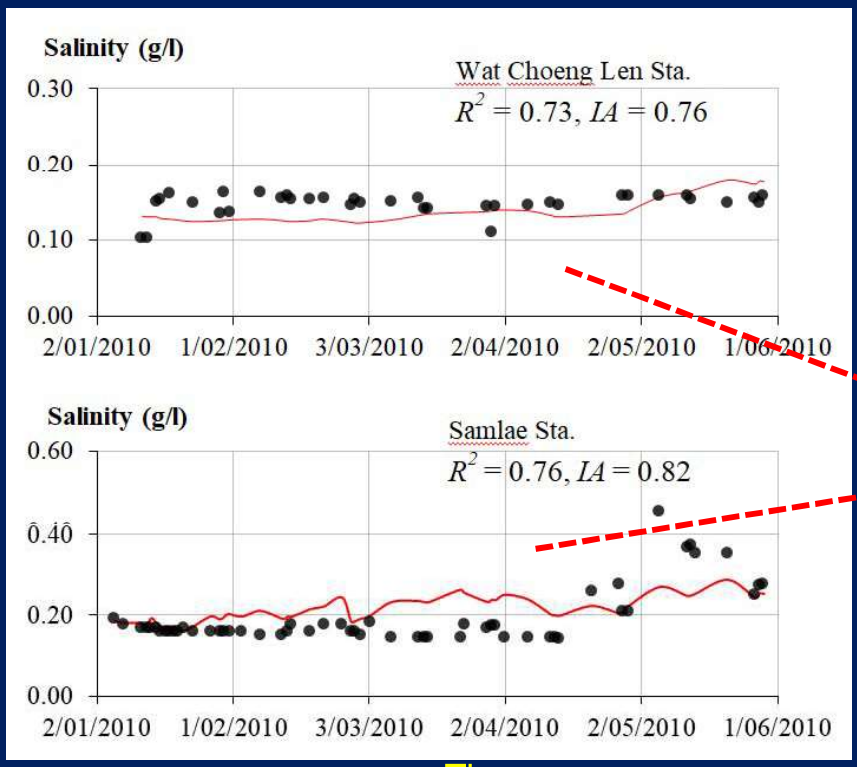


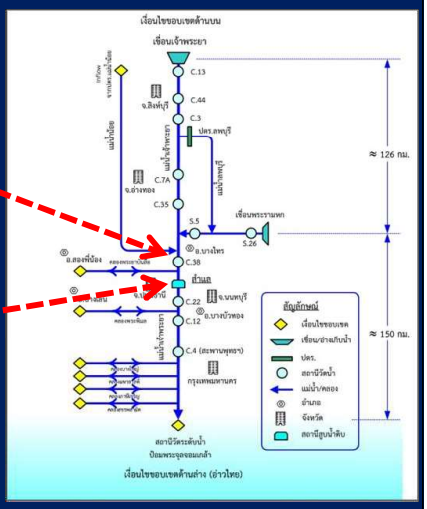
Water Level (m. MSL.)

Time

Manning's coefficient n = 0.030

Calibration AD Module (Jan. - Jun. 2010)

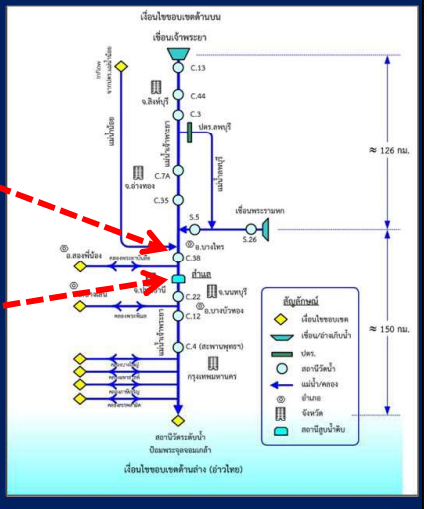




Time ⟶

Global Dispersion Factor = 800-1,600 m^2/s, Global Exponent = 0.1-1.0 and K_{mix} = 800-1,600 hr^{-1}

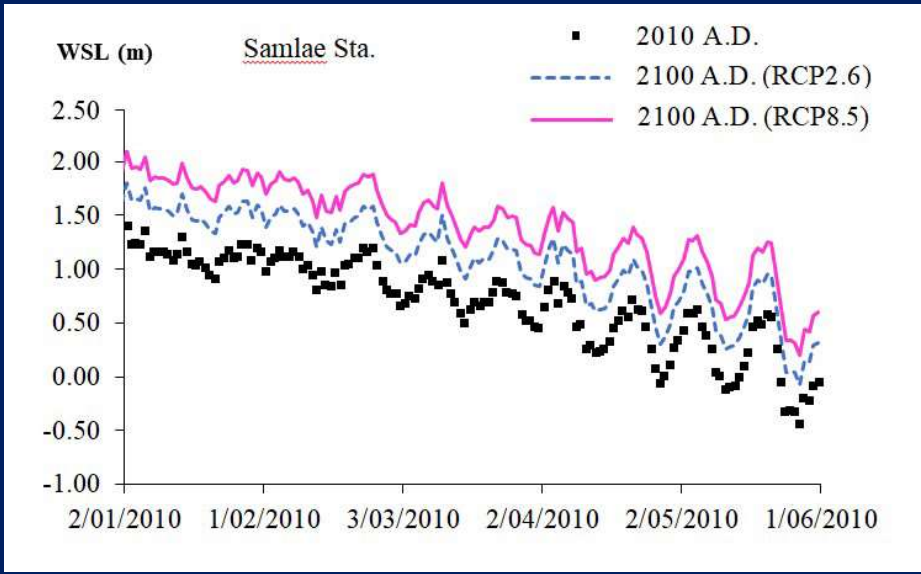
Validation AD Module (Jan. - Jun. 2012)



Time ⟶

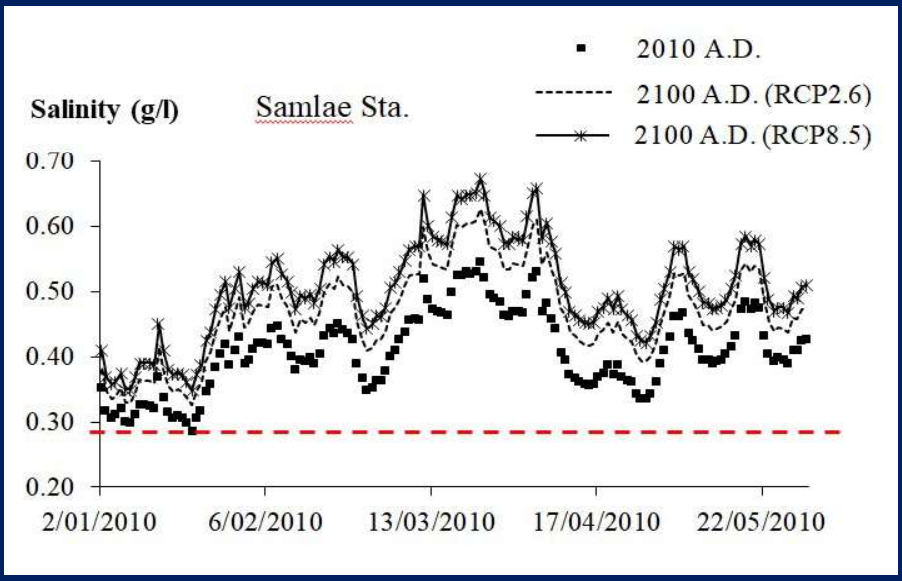
Global Dispersion Factor = 800-1,600 m^2/s, Global Exponent = 0.1-1.0 and K_{mix} = 800-1,600 hr^{-1}

Model Application



Water Level in the year of 2100 (IPCC AR5), with 0.40 m and 0.70 m sea water level rising in RCP2.6 and RCP8.5 scenario

Model Application



Salinity in the year of 2100 (IPCC SRES), with 0.40 m and 0.70 m sea water level rising in RCP2.6 and RCP8.5 scenario and salinity 30 g/l at downstream (Gulf of Thailand).

Model Application

Sea level rise and Salinity concentrations (MWA's criteria 0.25 g/l)

Year	salinity 0.25 g/l		Max. salinity at Samlae
	Name of location	Distance from Chao Phraya Dam (km.)	(g/l)
2008	Ban Kok Chang, Bang Sai	164.0	0.293
2025	Bang Sai, Bang Sai	163.0	0.296
2050	Maitra, Bang Sai	161.0	0.300
2075	BanPaeng, Bang Pa-in	144.0	0.370
2100	Ban Po, Bang Pa-in	142.0	0.375

Model Application

With constant salinity concentration 30 g/l at the Gulf of Thailand

Year	salinity 0.25 g/l		Max. salinity at Samlae
	Name of location	Distance from Chao Phraya Dam (km.)	(g/l)
2008	Sai Noi, Bang Ban	115.0	0.751
2025	Bang Chanee, Bang Ban	114.0	0.759
2050	Bang Chanee, Bang Ban	113.0	0.770
2075	Phong Pheng, Pa Mok	108.0	0.969
2100	Pa Mok, Pa Mok	106.0	0.987

Solution to the problem of salinity intrusion in Chao Phraya River.

(a) divert flow from Chao Phraya Dam

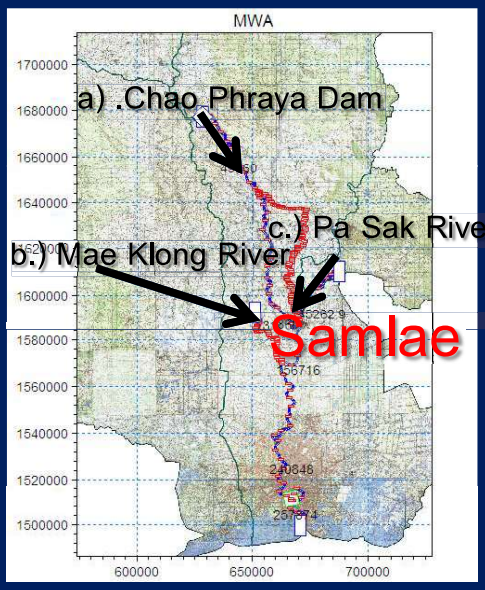
(Q = 30, 35, 40, 45, 50, 55, 60 m^3/s)

(b) divert flow from Mae Klong River

(Q = 0, 5, 10, 15, 20, 25, 30 m^3/s)

(c) divert flow from Pa Sak River

(Q = 0, 5, 10, 15, 20, 25, 30 m^3/s)

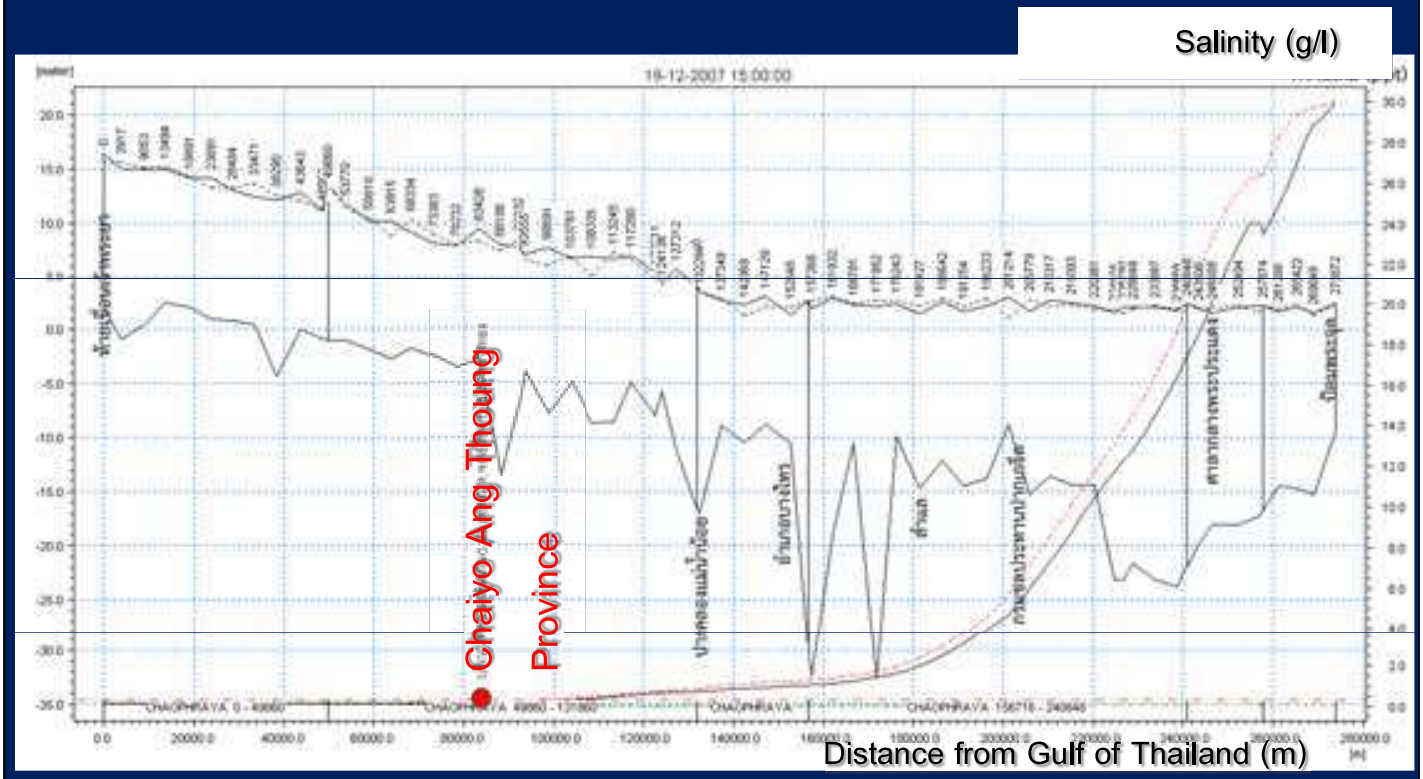


Model Application

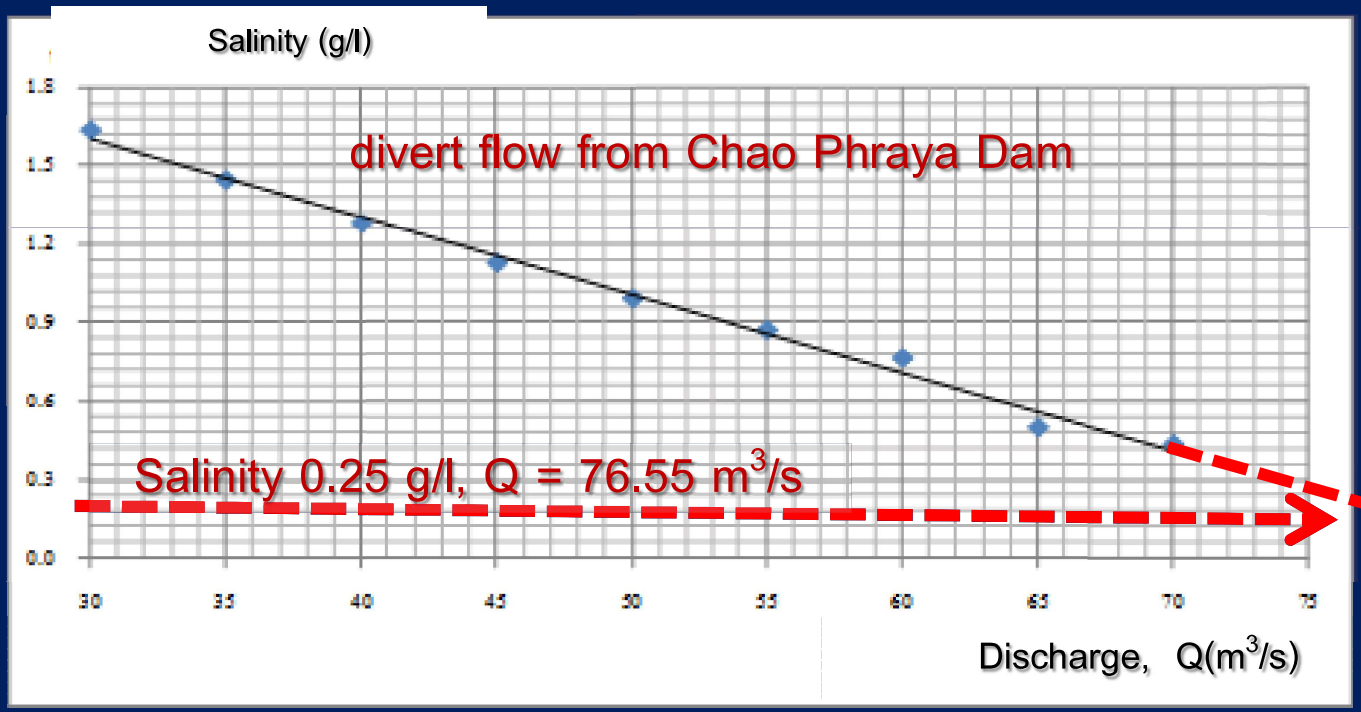
a. divert flow from Chao Phraya Dam

Discharge, Q (m^3/s)	Max. Salinity at Samlae (g/l)
30	1.637
35	1.449
40	1.282
45	1.130
50	0.994
55	0.874
60	0.768

> Salinity 0.25 g/l

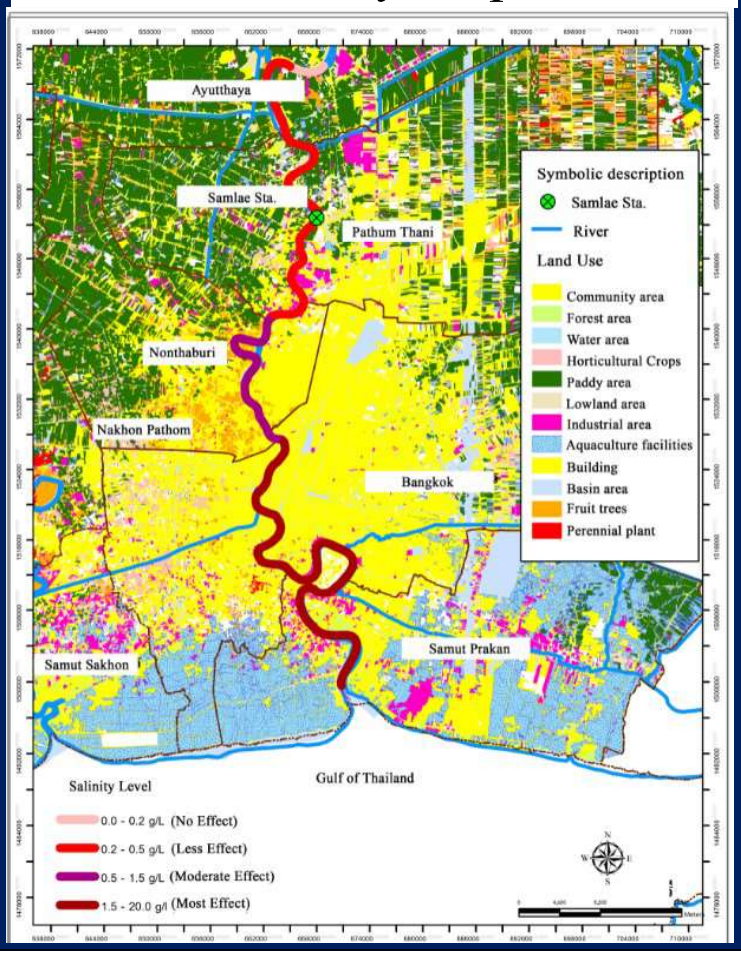


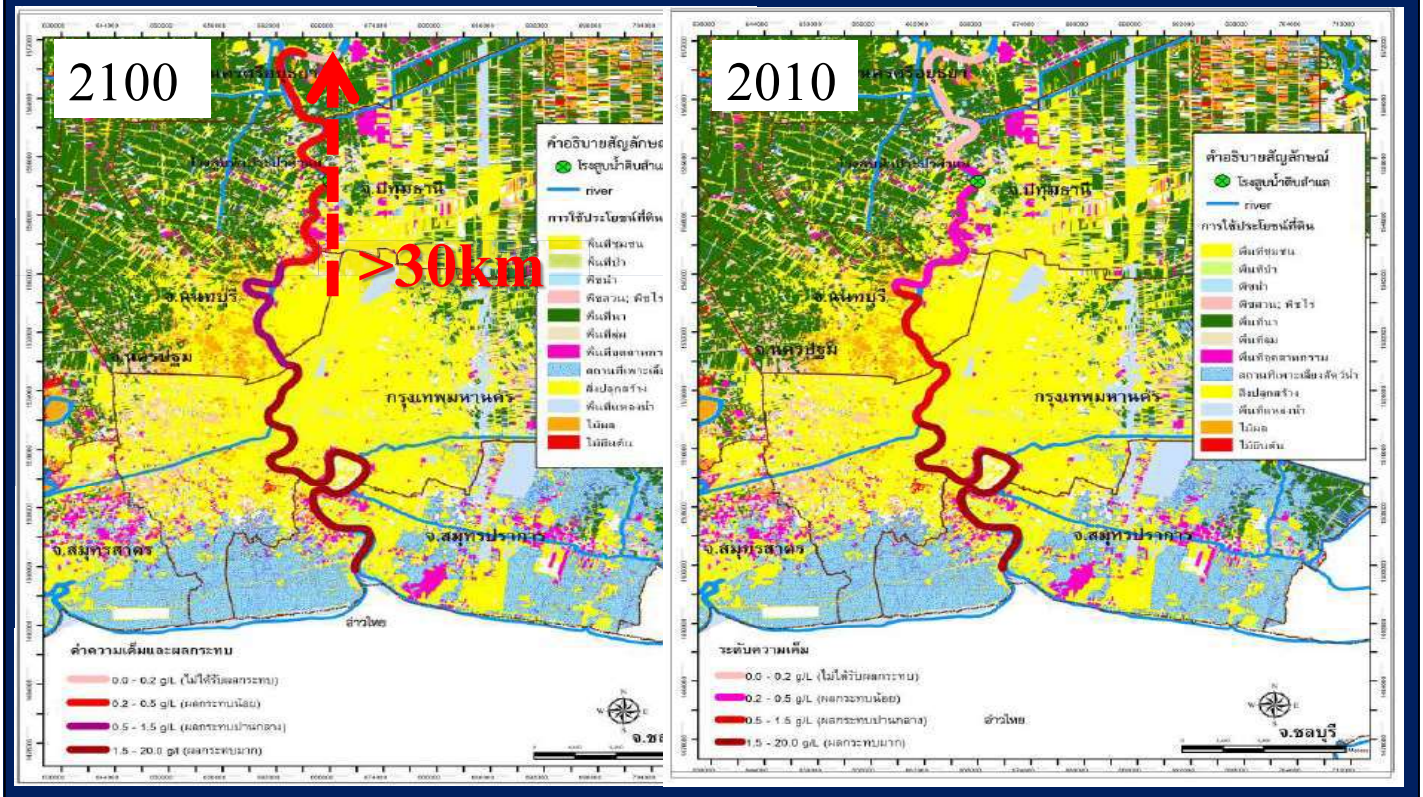
Salinity 0.25 g/l with divert flow discharge at Chao Phraya Dam Q= 30 m^3/s



Relationship between divert flow discharge at Chao Phraya Dam and salinity at Samlae Intake station

Salinity Map





Concluaion

-MIKE11 model was exploited to simulate the effects of climate and sea level changes on the raw water supply of MWA and agricultural areas in the lower part of Chao Phraya River in the year 2100.

-The simulation showed that salinity at Samlae will be exceeded 0.25 g/l. Therefore, it suggested to add new pump station at Klong Pongpheng, borderline of Ayutthaya and Ang Thong Province.

-For agricultural sectors, the value of 0.20 g/l exceeding standard and the pointed tip of salinity was at Ban Mai District, Ayutthaya Province (123 km. from Chao Phraya Dam).

Acknowledgement

BEDO: Biodiversity-Based Economy Development Office

for financial support

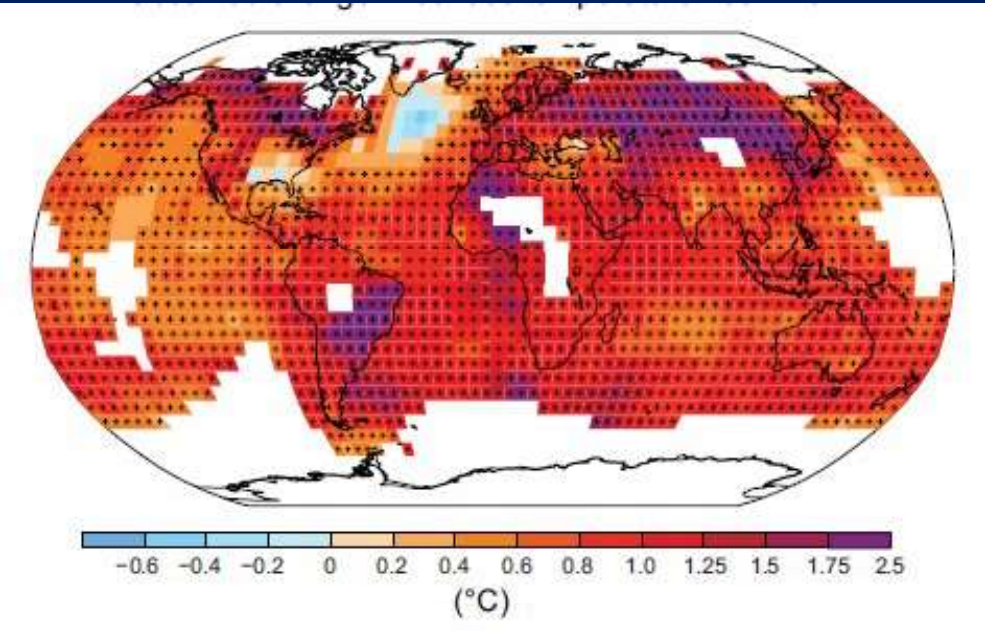
Metropolitan Waterworks Authority (MWA), Royal Irrigation Department (RID) and Pollution Control Department (PCD)

for providing fields data

Thank you

sanit.won@kmutt.ac.th สนิท วงษา

Changes in the Climate System - *Atmosphere*



Observed change in surface temperature 1901–2012

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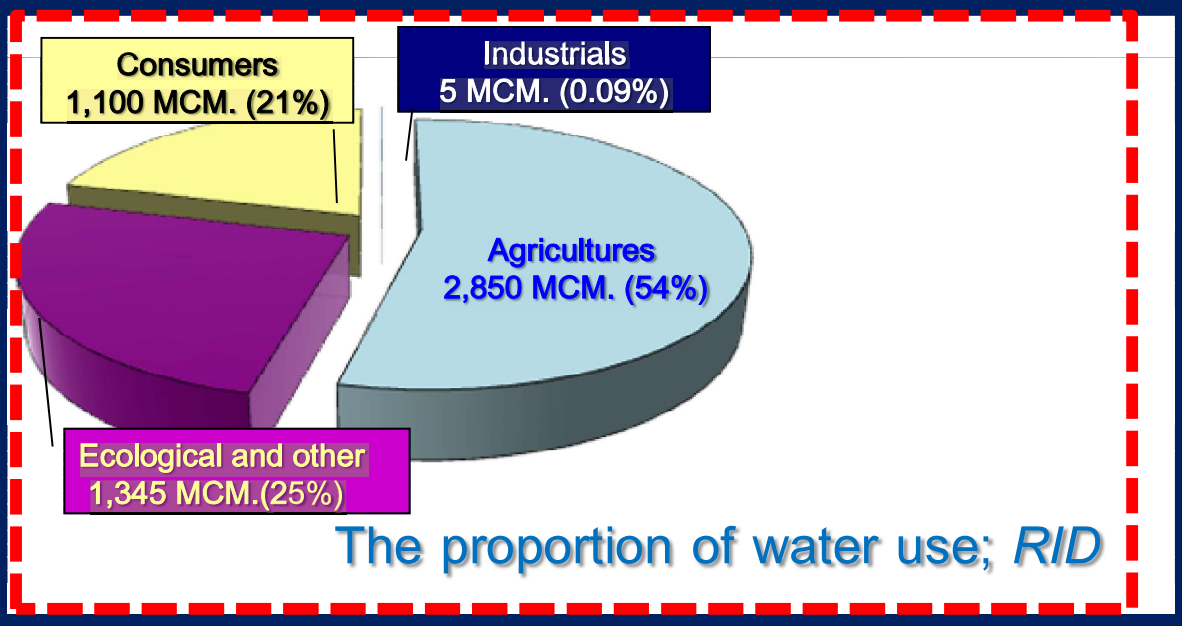

The proportion of water use; *RID*